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The CHEMIST

OCTOBER, 1940

AMERICAN INSTITUTE OF CHEMISTS

VOLUME XVII, No. 7

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By **Ed. F. Degering, F.A.I.C., and**

Rosemary Ince,

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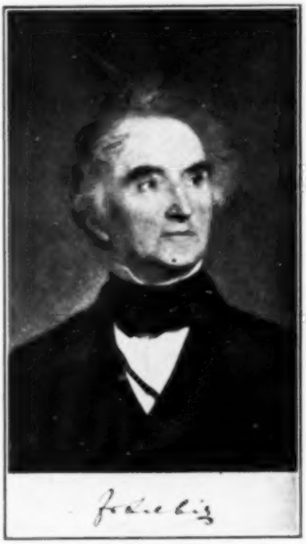
I. THE NEF LINE OF CHEMISTS,



B. Justus von Liebig, Teacher of Kekulé.*

IT MIGHT seem that fortune, genius, and perseverance communed in the nineteenth century through the person of Justus von Liebig to awaken certain important discoveries in the field of chemistry and chemical education. In the year 1803, a son was born to a German dye and varnish manufacturer at Darmstadt. The boy, Justus von Liebig, grew to love his father's laboratory so much that its attractions made the dull studies of school practically unbearable to his inquisitive mind. One would hardly say, however, that his education suffered as

*Picture by courtesy of **The Journal of Chemical Education.**

result of his early distaste for school. He more than found compensation in a thirst for education of another sort. "The lively interest which I took in my father's labors naturally led me to read the books which guided him in his experiments, and such a passion for these books was gradually developed in me that I became indifferent to every other thing that ordinarily attracts children."[1]

The mere reading of these books might have been fruitless. Having read about an experiment, however, Justus von Liebig proceeded to perform it himself—not once but again and again, "until I ceased to see anything new in the process or till I knew thoroughly every aspect of the phenomenon which presented itself."[1]

His greatest criticism concerning the instruction he received in chemistry at Bonn and Erlangen was that it was conveyed exclusively by lecture. Such a thing as a chemical laboratory for student experimentation was unknown.

By obtaining a grant from the government, Liebig went to Paris to benefit by the lectures of Gay-Lussac and other famous chemists. The young student attracted the attention of his lecturer, Gay-Lussac, by his work on fulminates. Through the influence of A. von Humboldt, Gay-Lussac was persuaded to take the ambitious, young chemist into his laboratory.

Young Liebig then decided to turn his interests into a life time vocation by becoming a professor of chemistry. But a grave difficulty stood in his way. He had strayed from the academical rule of the time by attending the foreign university of Erlangen instead of the university at Giessen, which all native sons of Hesse-Darmstadt were obliged by custom to attend. Again von Humboldt stepped in. By his intercession, the authorities forgave Liebig from straying from his native university and his Erlangen degree was accepted after an examination.

Through von Humboldt's recommendation, Liebig was given an extraordinary professorship of chemistry at Giessen in his twenty-first year, and a year later was elected ordinary professor of chemistry to fill a vacancy caused by the death of the previous professor. Here he opened the door for laboratory work by equipping the first experimental laboratory for college students. Through his influence Giessen University became the European center of chemical studies. These were happy years for Liebig. "I always recall with pleasure the twenty-eight years which I spent there; it was as if Providence had led me to the little university. At a large university, or in a larger place, my energies

would have been divided and dissipated and it would have been much more difficult, and perhaps impossible, to reach the goal at which I aimed, but at Giessen everything was concentrated in work, and in this I took passionate pleasure."[1]

During his twenty-eight years at Giessen, Liebig was offered numerous positions of greater honor and greater financial return, but he remained loyal to Giessen. In 1852, however, he left Giessen for the chair of chemistry at Munich which was offered to him by the Bavarian government. When he resigned he wrote to the Hessian minister, "During the present semester I have come to the conviction that because of the constantly increasing number of students, I can no longer conduct the practical work in the laboratory as has been my custom without seriously endangering my health. This is the chief reason for my decision to leave Giessen and go to another university."[2]

Thus Liebig gave up his work in laboratory supervision for the less strenuous task of lecturing. His lectures included both academic and popular subjects. He played an important part in governmental affairs since he was the president of the academy and adviser to the government in nutrition, natural science, agricultural, and industrial matters. Because of more free time at Munich, Liebig's literary activities increased. He was editor of *Annalen* and *Jahresberichte*. In 1865 he refused the chair of chemistry at Berlin, and remained at Munich until his death in 1873, following a short illness.

Pupils enrolled in his classes from all parts of the globe not only because of his unique chemical laboratory but also because of his remarkable teaching qualities. Frederick August Kekulé was one of his more remarkable and capable students.

Liebig's laboratory work for his students was conducted in an individual manner with each pupil working independently, for he placed great value on laboratory work. Thus each student learned to observe, think, and reason independently. As he stated, "The only complaint I had was from the attendant who could not get the workers out of the laboratory when he wanted to clean it."[1]

Liebig's enthusiasm and cheerful personality, as well as his skill and ability in problematical and laboratory work, added greatly to the success of his classes. His laboratory served as an example for other universities, for many universities built laboratories modelled on the same plan. Beside his labors for the improvement of chemical teaching, Liebig enriched the chemical field by three hundred and eighteen

memoirs under his own name in addition to numerous publications in collaboration with other investigators.

The life of Liebig was filled with accomplishment. "He opened the first experimental laboratory for college students, and the university (Giessen) soon became the European center of chemical studies. He had remarkable success as a teacher, and pupils streamed into his classroom from every country. The most illustrious chemists of the last century acknowledged their obligations to him as their master. He gave chemistry a settled position in Germany and turned it into a real science to be taught and learned by means of experiment. As an original investigator in the domain of chemistry he has shown himself a reformer of the sciences of physiology and agriculture. He may be said to be the founder of modern organic chemistry and its necessary method of analysis."[3]

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The Young Chemist and the Government Service

By Louis Marshall, F.A.I.C.

The fifteenth of a series of articles on the opportunities for chemists in the Government Service.

Bureau of the Mint of the Treasury Department

THE agency which is responsible for the assaying, refining, and storage of the precious metals received by the Government, and for the coinage production, is the Bureau of the Mint of the Treasury Department. This Bureau maintains six laboratories which are located at New York, Philadelphia, New Orleans, Denver, San Francisco, and Seattle. The work of these laboratories involves electrochemistry as applied to the assaying of the precious metals; not only gold and silver, but also those of the platinum group. The chemists of the Bureau, therefore, are in a position to acquire a great deal

of experience in this important field. The work is, of course, by its very nature, highly responsible and exacting.

In the field of the precious metals, one is accustomed to thinking in terms of small quantities, and this habit of thought merely serves to heighten one's amazement when he learns of the amounts customarily handled by the Bureau of the Mint. In the fiscal year, 1939, the electrolytic refineries of the Bureau produced 5,588,913 fine ounces of gold bullion, and 3,079,343 fine ounces of silver bullion. A fine or troy ounce is equivalent to 31.103 grams, whereas the ordinary avoirdupois ounce weighs 28.350 grams. The gold which is produced by the electrolytic process is about 99.97 per cent pure, or, as it is customarily expressed, 999.7 fine, and at the rate of $35.00 an ounce, its value amounts to about $195,611,955.00. The electrolytic silver which is obtained is at least 999.5 fine and likewise the metals of the platinum group are recovered in a high state of purity. One of the effects provoked by the unstable conditions of many countries has been a tremendous movement of gold to the United States. This type of importation had a value of about three billion dollars in 1939, and accurate assays of each individual shipment were carried out in the laboratories of the Bureau, particularly the one in New York. The work of refining these metals is done in the laboratories at New York, Philadelphia, and Denver. The production of the monetary coins intended for circulation is carried out in the mints at Philadelphia, Denver, and San Francisco. These establishments have reached a high degree of perfection in the art of producing coins of uniform composition. For example, silver coins which, according to law may vary not more than 0.3 per cent from the standard content of 90 per cent silver, are seldom found to vary more than 0.2 per cent, and are usually within 0.1 per cent of the standard. This uniformity of composition is also attained with the nickel coins which consist of twenty-five per cent nickel and seventy-five per cent copper, and the one cent coins consisting of ninety-five per cent copper and five per cent tin and zinc. In one year, the coinage mints produced more than one hundred and thirty million silver coins of various denominations, and more than three hundred million nickel and one cent coins. The uniformity in the composition of these pieces is made possible by the accurate assaying of the metals entering into the melt. No gold coins have been produced by the Mint in the last few years.

The assaying of the silver in the coins has to be done by a method which combines the advantages of a high degree of accuracy with

rapidity of operation. Such a method is the volumetric one devised by Gay-Lussac which is especially suited for the determination of silver in bullion. It is carried out in the laboratory of the Mint as follows: A large quantity of a solution of sodium chloride, adjusted to such a strength that 100 cc. will exactly precipitate 1.002 grams of silver, is prepared. This solution has a normality of 0.09297. Another solution of sodium chloride having one-tenth of this normality is also required. Now it is known beforehand that the silver content of the coins is ninety per cent plus or minus a few tenths. Therefore, the weight customarily taken for analysis is 1.1150 grams. This amount is added to a glass stoppered flask and dissolved in 1:1 nitric acid with the aid of heat. Then 100 cc. of the stronger solution of sodium chloride are added to the flask from a pipette. Also, by means of a smaller pipette, two cc. of the weaker solution are added. The 100 cc. of the stronger solution precipitate 1.002 grams of silver, and the two cc. of the weaker solution precipitate 0.002 gram, making a total of 1.004 grams of silver precipitated as chloride. The flask is then stoppered and placed in a mechanical shaker where it is agitated violently for four minutes. This treatment causes the precipitate to coagulate and settle quickly. The flask is then removed, and opened, and the clear supernatant liquid above the precipitate is treated with one cc. more of the weaker solution of sodium chloride. The liquid is then shaken very slightly, and the cloud produced by the last addition of the sodium chloride is observed. An experienced analyst can tell, by the density of the cloud, just what portion of the one cc. of sodium chloride solution was needed to combine with the excess silver present in the solution. If the cloud produced by the formation of silver chloride is sufficiently dense to indicate that the entire cubic centimeter has been used, the flask is again placed in the shaker to coagulate the precipitate and cause it to settle rapidly. It is removed and one cc. more is added, and as before, the fraction of the cubic centimeter which was necessary to combine with the excess silver is noted. Let us say that in one determination, after adding the 100 cc. of the stronger solution and two cc. of the weaker solution, it was found necessary to add one and one-half cc more of the weaker solution. Now the 100 cc. is equivalent to 1.002 grams and the three and one-half cc. is equivalent to 0.0035 gram, making a total of 1.0055 grams of silver present in the sample. If the latter weighed 1.115 grams, the percentage of silver is $1.0055/1.115 = 90.17\%$. In the hands of an experienced analyst, this method gives very reliable results, and many determinations

can be made in a comparatively short time. It is the method that is used for the routine determination of silver in all the laboratories of the Bureau of the Mint.

The assay of gold bullion is a very complicated procedure, but as can be expected, in view of the great importance of the metal, it has been developed to the stage where the determination can be made with extreme accuracy. The laboratories of the Mint report the percentage of gold in bullion to the nearest hundreth of one per cent. For example, a specimen may be reported as consisting of 90.36 per cent gold, or, as it is customarily expressed, it is 903.6 fine, and the decimal figure is usually accurate to within one point plus or minus. An outline used for the determination of the precious metal in bullion, shows that the determination is not an easy one. The bullion cannot be treated simply with nitric acid to dissolve the silver and base metal and leave the gold behind. The separation would not be complete. The base metals would interfere. The silver, if present to an extent less than three times that of gold, would not go entirely into solution. The gold would not be the only metal unacted upon by the acid, and a satisfactory determination could never be made.

The method which is used for the determination of gold and silver in bullion, the fire assay, involves the operations of cupellation, inquartation, and parting. Usually a one-half gram sample is taken for analysis. It is wrapped in an amount of sheet lead which is dependent upon the approximate proportion of silver and gold in the sample. For example, if the percentage of silver plus gold amounted to ninety, then seven grams of lead would be used with the one-half gram of the bullion. The charge is added to a cupel which is a small shallow vessel of bone ash consisting mainly of calcium phosphate, with small amounts of magnesium phosphate, calcium fluoride, and calcium carbonate. The cupel and charge are then placed in a muffle furnace which is maintained at a bright red heat, (about 900° C.) During cupellation, the lead oxidizes to litharge which is molten at this high temperature and is absorbed into the porous surface of the cupel. The other base metals, such as copper, nickel, and zinc, are also oxidized and, if present in moderate amounts, they dissolve in the liquid litharge and are absorbed into the cupel. The gold and silver are unaffected. The heating is continued until all the base metal has been separated from the gold and the silver. This point is determined by the appearance of a flash, the "blick" which is due to the solidification of the gold and silver

after the base metal has all been oxidized; this solidification releasing the latent heat of fusion of the metals thus giving rise to the "blick". The purpose of the cupellation is, therefore, the separation of the gold and silver from the base metals with which they are alloyed.

When the process has been completed, the cupel is removed from the furnace, and the gold-silver button is taken out and cleaned. It is then weighed to the nearest one-tenth of a milligram.

The next operation is that of inquartation. If the proportion of silver to gold is less than three to one, the addition of nitric acid to the alloy will not cause all the silver to go into solution, and the separation of the two metals will be incomplete. Therefore, the gold-silver button is wrapped in a quantity of pure silver foil which is usually ten times its weight. A few grams of lead are then added, and the mixture cupelled to alloy the added silver with the gold-silver button. The alloy is then removed and treated with nitric acid to dissolve out the silver. The gold which, of course, is unaffected by the acid treatment is filtered off, dried, and annealed. It is then weighed on a very delicate assay balance, and its weight, subtracted from the weight of the original gold-silver button, gives the weight of the silver. The percentage of each metal in the sample of bullion is then determined.

The determination requires a great deal of practice and skill, especially since the accuracy of the results is a matter of utmost importance. It must be remembered that the Bureau of the Mint receives large quantities of bullion, both gold and silver, from commercial establishments, and the amounts of cash paid for this bullion is entirely dependent upon the assays for gold and silver that are conducted in the laboratories of the Bureau. Vast sums of money are involved in these bullion transactions. The work is therefore highly responsible and exacting, and demands the services of men skilled in the field. In a large laboratory such as the one in New York, the work involved in the assaying of gold is divided among several men. One of them is engaged entirely in weighing samples, another does the furnace work, a third takes care of the acid treatment, and so on. This procedure makes it possible to complete more assays during a given period of time than otherwise possible, but it also tends to make the work monotonous and routine. The Bureau employs forty-two junior assayers, six assistant assayers, and seven full assayers, making a total of fifty-five in its six Mint laboratories.

Chemical Warfare Service

The War Department is organized into several branches which require chemists, the most important being the Chemical Warfare Service. The origin of this Service dates back to June 4, 1920, when the National Defense Act prescribed its organization and functions, and designated it as a separate and distinct branch of the Army. When the nation entered the World War in 1917, there existed no organization in the Army devoted to the pursuit of chemical warfare or to protection against it. This handicap, however, was largely overcome, thanks to the feverish researches of many American chemists, physicists, physiologists, and other specialists. This new and revolutionary form of warfare became so important that it was necessary to establish a separate organization within the Army devoted to the study of chemical warfare in all its phases. Hence the provision for the formation of the Service in the National Defense Act of 1920.

Modern chemical warfare can be said to have begun on the twenty-second of April in 1915. On that historic day, the Germans launched the first gas attack on a four mile front north of Yprés. The story is that a German soldier, a deserter, was questioned by the British regarding the activities of the enemy. He told them that the German army was planning the use of poison gas, and that the cylinders had already been installed in the trenches. His tale seemed so absurd and impossible, however, that no credence was given to it. The English did not believe that the Hague rules of warfare which forbade the use of projectiles whose only object was to give out suffocating or poisonous gases would be wantonly broken.

On that day, however, modern chemical warfare began. The military situation had reached a stalemate, and the vast stage was set. The actors, thousands of them unknowingly were about to participate in an unforgettable tragic drama. The weather conditions were just right. The wind was blowing in the direction of the enemy. Then at five o'clock in the evening, several thousand cylinders of chlorine gas, previously installed in the German trenches, were opened. The poisonous gas, drifting down over the soldiers of two French divisions, was so unexpected, so powerful in its effects, so sudden, that the men who were not overcome fled in terror and confusion. The attack was devastating in its effects. It lasted scarcely five minutes, yet it left upon the field of battle five thousand dead and many more wounded. The German troops were able to penetrate unopposed to a depth of three and one-half miles where they entrenched. Had they pushed on, they might

have been able to reach the sea thus breaking the blockade which slowly but surely was starving Germany into submission. As it was, it took seven hours before the demoralized troops of the allies had recovered sufficiently to counter attack which they did at midnight. The German troops thus fumbled a brilliant opportunity, and from that day on, each of the warring nations mobilized its chemists and technicians to devise offensive and defensive methods of chemical warfare. A new era of military science was thus inaugurated; a more subtle era; one in which the offensive was carried out, not by bullets or highly explosive shells, but by myriads of little molecules.

Since the World War, most of the nations of the world have devoted a great deal of attention to researches in chemical warfare. Thousands of compounds have been investigated to determine their suitability, but the requirements which chemical warfare agents must possess are so specific and rigid, that not more than about a score have been found to have tactical value. This statement may be only approximately true, since each nation jealously guards and keeps secret its discoveries in this form of warfare. Extensive researches in this country, however, appear to indicate that future wars will be characterized, not so much by the employment of new chemical agents, as by the more extensive and efficient use of those already known.

As already stated, chlorine was the first chemical agent used. From the standpoint of physiological action, the gas is characterized as an irritant. It causes inflammation of the respiratory organs, produces quick disability, and if breathed in sufficient concentration, or even in low concentration for sufficient time, it causes death by asphyxiation. The fact that chlorine is very active chemically, and readily combines with many substances, makes it relatively easy to design a protective agent to neutralize it. In the first chlorine gas attack, some soldiers obtained a measure of protection by knocking the bottoms from bottles, filling the remaining portions with earth and breathing through them. An early form of protection against chlorine was a respirator known as the "Black Veiling". It consisted of a cotton pad soaked in ordinary washing soda solution and provided a fair degree of security against the gas. Later, the veiling was improved by the addition of sodium thiosulphate and glycerine.

Phosgene or carbonyl chloride is another gas which World War experience showed to be useful. It was first employed in cloud gas attacks mixed with chlorine, by the Germans against British troops. It is a colorless gas having a sweetish odor resembling that of freshly

cut hay, but by no means as wholesome! Like chlorine, it is a lung irritant. It is much more toxic than chlorine, can be readily liquified under pressure and is easily vaporized when the pressure is released. Technically, it is classed as a non-persistant casualty agent. That is to say, it is capable of producing casualties during a period of not more than ten minutes after it has been applied to a given area.

An agent which has a different physiological effect from either of the two already mentioned, is ethyldichlorarsine, $C_2H_5AsC_{12}$. It is classified as a vesicant and sternutator. A vesicant is a substance which is readily absorbed or dissolved in the exterior parts of the body, causing inflammation, burns on the skin, and destruction of tissue. It is usually effective in either the vapor or the liquid form, though the action of the liquid is generally more rapid and violent. A sternutator is a substance, which when present in the air, causes irritation of the nose and throat, and violent sneezing. Under ordinary conditions of temperature and pressure, ethyldichlorarsine is a liquid having a very disagreeable odor. The compound has the peculiar property of causing paralysis of the fingers. It is a persistant agent, its effects being felt during a period of one to two hours after application to a given area. It may be destroyed by an aqueous solution of caustic soda which hydrolizes the compound.

The substance which, military experts agree, will be the most important chemical agent in future wars, is mustard gas, or beta chlorethyl sulphide. It is a dangerous vesicant substance which dissolves in skin or lung tissue and then produces serious burns. Ordinary clothing affords no protection against mustard gas. In the chemically pure state, it is a colorless oily liquid with a strong garlic-like odor. Its persistance is such as to be capable of producing casualties during a period of—depending on the weather—twenty-four hours to several weeks after it is applied. Its hydrolosis is accomplished slowly by cold water; much more rapidly by hot water. It may be destroyed by bleaching powder. The effects of mustard gas are generally felt from two to six hours after exposure. Droplets of the compound, which happened to be brushed on to the clothing of troops passing through contaminated areas during the World War, often caused severe burns.

The process used for making mustard gas has been greatly simplified and cheapened since the war. It is an agent that is a highly effective casualty producer. It can be applied over a given area by several methods, the latest and deadliest being the method of spraying over a large area by airplane. For these reasons, it appears safe to assume

that mustard gas will play the predominating rôle in future gas warfare. The Chemical Warfare Service, realizing this, is devoting a great deal of attention to methods of protection against this agent, and to methods of neutralizing its harmful effects, once exposure has occurred.

Lewisite is another dangerous vesicant agent. It was developed during World War days by an American chemist working in Washington, D. C., but it has never actually been used in warfare. It is an arsenical, dark green liquid having an odor resembling that of geraniums. There is little doubt but that it will find use in future conflicts.

Brombenzylcyanide is another substance which was found useful in chemical warfare. Physiologically it is classed as a lacrimator. That is, it produces a copious flow of tears, and intense though temporary eye pains. This heavy, dark brown liquid with an odor of sour fruit, was first used by French troops during the war. It is a very corrosive substance, and is usually placed in containers which are lined with lead. The compound produces a quick disabling effect though the disability is not lasting.

A similar chemical agent, which was developed since the World War, is chloracetophenone, the common "tear gas" used occasionally to quell civil disturbances. The compound, which is an aromatic ketone, is a white crystalline solid. It may be dissolved in a solvent, and disseminated as minute liquid droplets by special firing instruments.

White phosphorous is useful in chemical warfare because it burns on exposure to the air, producing a dense cloud of white smoke which has great obscuring value. Solid particles of white phosphorous coming in contact with the flesh produce severe and painful burns. This agent is also used for its incending properties by means of which the destruction of enemy material is effected.

The greater part of the researches in chemical warfare in this country are carried out at the Edgewood Arsenal in Maryland. This Army post contains shell filling plants and proving grounds for chemical agents. Some of the work done at the Arsenal, such as the investigations into the causes of physiological action, the laws governing the obscuring value of smokes, and the laws governing the absorption of gases, has been of a fundamental nature. Largely as a result of researches carried out here, the Army has developed a standard gas mask which provides complete protection, to the eyes and the respiratory organs, against all known chemical warfare agents, in such concentrations as are ever likely to be encountered in the field. Methods are

being worked out for the protection of the body against the action of vesicant agents and for protection against possible new chemical compounds. The work is highly difficult and complex, and a staff of able chemists is employed to carry out the many necessary lines of investigation. The Edgewood Arsenal employs one chief chemist, one head chemist, three principal chemists, five senior chemists, seven chemists, eight associate chemists, seven assistant chemists, and four junior chemists; making a total of thirty-six.

The experience of the World War demonstrated that an army or a civilian population that is unprotected against chemical attack stands in danger of annihilation. Military authorities recall that the first use of chlorine in warfare took a toll of five thousand lives, and well do they realize that if the attack had been expected and if the soldiers had been equipped with suitable gas masks, the casualties would have been negligible. Furthermore, chemical warfare has been developed to a far higher state of efficiency than it was in the days of 1915. The capacity for carrying out an offensive with chemical agents has been enormously increased. It is therefore not difficult to understand why the nations of the world are making today the gigantic efforts to provide all of their nationals, men, women, and children, with suitable protection against chemical attack.

These efforts at protection have also marked the activities of the United States Chemical Warfare Service. A gas mask has been developed which effectively guards the eyes and respiratory tract against all chemical agents which, so far as is known, are likely to be encountered in the field. The principle of operation of the mask is that the air which is inhaled is first caused to pass through a mechanical filter which is constructed of such material as to prevent the entrance of smoke or dust. It contains charcoal and soda lime to absorb and neutralize the acidic, toxic, and irritating gases and vapors.

The purified air is breathed and then expelled mechanically from the mask. The problems involved in the manufacture of this device have been solved, and in the event of an emergency, this nation is prepared to produce the gas masks in the immense quantities which will be needed.

For protection against vesicants of the mustard type, it has been found necessary to develop clothing which will prevent these agents from coming into contact with the body. Suitable material for this purpose has been produced and its manufacture in large quantities has been found to be feasible. Similarly, the conditions necessary for the

construction of gas-proof shelters in which troops that must remain in gassed areas may eat, rest, and sleep, have been established.

In the present European war, chemical weapons have, as yet, played no important part, but smoke screens and incendiary agents have been used. Both Great Britain and Germany have made great efforts for defense against gas attacks, and doubtless both nations have the means to conduct offensive action with chemical agents. Possibly that is why neither side dares take the initiative, but it is by no means certain that chemical warfare will continue to play a negligible rôle in this conflict. In the Italo-Abyssinian campaign mustard was used extensively against a foe who had not the means to retaliate in kind.

The subject of chemical warfare has provoked innumerable discussions and controversies. It has been attacked as peculiarly cruel and inhuman, though why it is more cruel, or more brutal, or more inhuman than machine gun bullets or immense high explosive shells, has never been adequately explained. Attempts have been made by the nations of the world to come to an agreement restricting the use of chemicals in war, the United States often taking a leading part in these efforts. But at the present time no general treaty exists which forbids the employment of chemical agents. In this connection, it is noteworthy that a committee of the League of Nations Assembly reported that: "There is only too much reason to fear, after the experience of the late war, that any country fighting for its life will avail itself of whatever weapon it may find it possible to use effectively. It is therefore necessary, however unfortunate it may be, to anticipate, if another war breaks out, that chemical weapons will be used." This is why researches, in all the phases of chemical warfare, are continually being carried on throughout the world.

"With all the advance made in the sciences, and in technology and the arts, during the past few years, and all we have learned from experience, the time has arrived when we can have anything we want, within reason, if we but write a sufficiently clear and intelligent specification.

"In the future what we have, what we are, and what we can do will be limited only by our imagination and our faith—and human nature."

—From *Yours to Venture,* by Robert R. Updegraff.

Ludwig Saarbach

It is with deep regret that THE AMERICAN INSTITUTE OF CHEMISTS records the death of its charter member Ludwig Saarbach on July 17, 1940, in New York, N. Y.

Dr. Saarbach was born on July 16, 1856, in Mainz, Germany. He received the Ph.D. degree from the University of Leipzig and also studied at the University of Giessen.

He was employed by E. de Haen, Hanover, Germany, from 1882 to 1884; by the Citric Acid Works, in Elba, until 1886, and by Maas and Waldstein, New York, and the Weidmann Silk Dye Company in Paterson, New Jersey, until 1890, when he established a consulting chemical laboratory in New York. He served as a consultant until his death. He was the author of several publications and held a number of patents. He specialized in the manufacture of technical and pharmaceutical preparations, citric acid, tannins, and organic chemistry, and was highly esteemed in his profession.

Karl R. Lindfors

THE AMERICAN INSTITUTE OF CHEMISTS records with deep regret the death of its charter member, Karl R. Lindfors on February 12, 1940, in Saginaw, Michigan.

Mr. Lindfors was born July 14, 1876, in Geffle, Sweden. In 1894 he was graduated as a chemical engineer from the Oerebro Technical College, Sweden, followed by post-graduate work in sugar chemistry at the University of Agriculture, Berlin, Germany. He worked two years as assistant chemist in the Sugar Factory at Steffenstorp, Sweden; one year in a similar position at Gutschdorf, Germany; chief chemist of a Sugar Factory at Faulbryck, Germany; two years in a beet seed testing laboratory at Heidersdorf, Germany, and one year as chemist in a sugar factory in Berlin. From 1906 to the time of his death he was general chemist of the Michigan Sugar Company, Saginaw, Michigan. He specialized in beet sugar manufacture, technology, and chemical control, and was the author of a number of articles in his specialized field.

Wolf Kritchevsky

It is with deep regret that THE AMERICAN INSTITUTE OF CHEMISTS records the death of its charter member, Wolf Kritchevsky, on June 27, 1940.

Dr. Kritchevsky was born September 16, 1886, in Gomel, Russia. He was trained in chemistry at the Universities of Berne and Geneva, Switzerland, and at the University of Grenoble, France. He also did post-graduate work at the University of Berlin.

From 1912 to 1916, he served as instructor in chemistry at the University of Minnesota, Minneapolis, followed by three years as research director of the chemical products and dye department of the Sherwin-Williams Company of Chicago. In 1919, he became chemical director of the Sunbeam Chemical Company, Chicago, which was succeeded by the Rit Products Corporation in 1921. He was treasurer of the latter company until his death. He specialized in the manufacture of coal tar products and dyes as intermediates, aromatic synthetics, and medicinal synthetic products. He was the author of many publications in the field of organic chemistry and held numerous patents both in the United States and abroad.

He was a member of many chemical societies among which were the American Chemical Society, Sigma Xi, American Association for the Advancement of Science, American Association of Textile Chemists and Colorists, and the Chemists' Clubs of New York and Chicago.

"What of the girl who has been interested in chemistry during her four years in college? . . . The staff members of the Institute of Women's Professional Relations . . . interviewed over a hundred chemists, asking where the college woman, trained in chemistry, might best look for interesting work . . . Wherever the interviewers went, they were asked why college girls did not prepare themselves for the auxiliary jobs connected with chemistry, where the field is far from crowded." Advertising, selling, promotion, secretarial and library work are among such auxiliary jobs.

—From *Women's Work and Education.*

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Society of Chemical Industry Meetings

The American Section of the Society of Chemical Industry has planned the following meeting schedule for 1940-41.

1940

November 15—Program on plastics. Details of meeting to be announced.

December 6—Joint meeting with American Chemical Society, New York Section.

1941

January 10—Perkin Medal Award to Dr. J. V. N. Dorr, President of The Dorr Company, Inc. Joint meeting with American Chemical Society, American Institute of Chemical Engineers, The Electrochemical Society and Société de Chimie Industrielle. Details of meeting to be announced.

February 28—Details of meeting to be announced.

March 7—Joint meeting with American Chemical Society. Presentation of Nichols Medal by American Chemical Society.

April 18—Joint meeting with American Chemical Society, New York Section.

NORTHERN LIGHTS

By Howard W. Post, F.A.I.C.

According to Max W. Ball in *This Fascinating Oil Business,* "Canada's great oil reserve . . . the largest known in the world, is . . . in the oil sand deposits of Northern Alberta." He states that the latest United States Geological Survey estimate of the proved reserves of the world is some twenty five billion barrels, only slightly less than the world's total production to date, estimated at thirty seven billion barrels. The Dominion Mines Branch, according to Mr. Ball, has estimated that the Alberta sands contain at least one hundred billion barrels of oil. An estimate made by our own Bureau of Mines places this figure much higher—at two hundred and fifty billion. To continue with Mr. Ball's description we read, "Canada has three distinctions: It has the world's most northerly oil field, the world's largest known oil deposit, and the world's only city that has based three oil booms in one field."

We recommend to our readers two unusually interesting articles of a popular nature on modern contributions to the galaxy of industrial products. "Panes without Pain" on page two of the *C-I-L Oval* for June, 1940, describes the latest products of the safety glass industry and includes a few historical paragraphs which proved quite informative. We read, "A more graphic illustration of the potential and dangerous arsenal stored in a pane of glass occurred during the Halifax explosion. Thousands of the victims would have escaped unscathed had they not been watching the burning ship through their windows. The terrific blast turned the panes into flying splinters that cut, maimed and killed." Butacite is mentioned, a vinyl acetate plastic for which a portion of the development work was done by Shawinigan Chemicals, Ltd. "Chemical Warfare" and its companion editorial "Stop Swatting" outline methods for insect elimination which are to take the place of the time-honored habit of percussion applied by the humble fly-swatter. Germs, they tell us, remain on the smashed body of the fly and are never efficiently eliminated.

Occasionally we find a reference in American print to the fact that so many graduates of West Point and Annapolis have eventually gone into business after a period of military or naval services and have proven themselves quite capable. Recently we noted a comment in *Canadian Chemistry and Process Industries,* of July, 1940, calling attention to the fact that "We have a Director of the National Research Council—an organization devoted mainly to applied chemistry and physics—acting as a Lieutenant General overseas, not to mention a Professor of Dairying directing a division." So the shoe is, after all, on the other foot in time of war.

Arnold Hoffman and Company, Inc., Providence, Rhode Island, are celebrating their one hundred and twenty-fifth anniversary in the chemical industry.

CHEMISTS

The United States War Department has contracted with E. I. du Pont de Nemours and Company to operate a $14,000,000 T.N.T. plant to be built at Wilmington, Illinois. Stone and Webster Engineering Company, New York, N. Y. have the contract to design and construct the plant, which is expected to require eight months for completion. This plant is one of a chain of war industries to be built by the government at a cost of $1,000,000,000.

This war industries program also provides for $80,000,000 for expansion of synthetic rubber plants in the United States. An additional 416,000 tons of natural rubber for defense requirements are to be purchased.

The Reconstruction Finance Corporation is calling for a conference of those interested in tin smelting projects for the purpose of establishing a tin smelting plant in this country.

Exports of manganese from Brazil to this country will be increased under an agreement with the Brazilian government. Additional chrome ore imports have been arranged for from Cuba. Stocks of antimony, tin, and tungsten are also being increased.

Foster Dee Snell, F.A.I.C., recently addressed the Detroit-Strathmoor Kiwanis Club on the subject of "Chemistry Serving Industry". He discussed the diversified problems brought to the consultant by manufacturers.

Anthony William Deller, F.A.I.C., is head of the International Nickel Company's new Patent Department.

Dorr Selected to Receive Perkin Medal

Dr. J. V. N. Dorr has been elected to receive the Perkin Medal of the Society of Chemical Industry for 1941. The medal is awarded annually for valuable work in applied chemistry. The selection is made by a committee representing the five chemical societies in the United States.

Dr. Dorr was born in Newark, New Jersey, January 6, 1872. He received the B.Sc. degree from Rutgers University in 1894, the honorary degree of Master of Engineering in 1914, and the honorary degree of Doctor of Science in 1927 from the same institution.

His many inventions include the Dorr Classifier, which has been called editorially "the piece of equipment that comes nearest to being in universal use in modern hydrometallurgy", the Dorr Thickener, the Dorr Agitator, and Continuous Counter Current Decantation. He is at present the active head of The Dorr Company, Inc. which he organized. He is a member of many scientific societies.

The medal will be presented on January 10, 1941, at a meeting to be held at The Chemists' Club, 52 East 41st Street, New York, N. Y. Details will be announced later.

Dr. E. V. McCollum, professor of biochemistry, School of Hygiene and Public Health, The Johns Hopkins University, delivered the annual lecture for the University of Alabama Chapter of Sigma Xi on April seventeenth. The subject of his lecture was, "The Diet in Relation to Dental Disease."

Corning Glass Works, Corning, New York, informs us that national advertisers will be interested in the amendment of a recent decision of the U. S. Circuit Court of Appeals in St. Louis, Missouri, to the effect that the word "Pyrex", a trademark of Corning Glass Works, is not public property. The case which was thus settled originated in a suit brought by The Obear-Nester Glass Company of St. Louis charging infringment of their trademark "Rex". The Federal District Court ruled in favor of Obear-Nester. The decision was reserved by the United States Circuit Court of Appeals. This confirms Corning's ownership and exclusive right to the word "Pyrex" which it adopted in 1915, and which has subsequently been advertised throughout the world.

Harold W. Feuchter appointed manager of Baker Chemical Company's New York Office

General sales manager Ralph A. Clark of J. T. Baker Chemical Company in Phillipsburg, N. J., recently announced that Harold W. Feuchter had been appointed as manager of their New York office at 420 Lexington Avenue, New York, N. Y.

Mr. Feuchter has been associated with J. T. Baker Chemical Co. for five and a half years, contacting accounts in upper New York State. He succeeds Charles H. Slater, who was recently appointed divisional sales manager of the Fine Chemical Division with headquarters at Phillipsburg, N. J.

Donald Price, F.A.I.C., chief chemist of National Oil Products Company, Harrison, New Jersey, was elected chairman of the Metropolitan Microchemical Society.

The American Chemical Society is coöperating with the National Defense Research Committee to "investigate, examine, experiment, and report upon any subject in pure or applied chemistry connected with the national defense". The committee appointed to coöperate with the National Defense Research Committee includes Roger Adams, Chairman; James B. Conant, T. L. Davis, W. K. Lewis, Charles L. Parsons, E. R. Weidlein, F.A.I.C., R. E. Wilson, the president of the American Chemical Society, and Thomas Midgley, *ex officio*.

Oliver V. Renaud, who received his M.D. from the University of Illinois, has joined the staff of Foster D. Snell, Inc., Brooklyn, N. Y., and is in charge of clinical work.

Albert F. Guiteras, who received his B.S. degree from Lafayette College and Ph.D. from Goettingen University, will join the staff of Foster D. Snell, Inc. on October 1st. He has previously been with the Department of Health of the City of New York and the United States Department of Agriculture, Food and Drug Administration.

The American Association of Textile Chemists and Colorists will meet October eighteenth and nineteenth at the Hotel Commodore in New York, N. Y.

The facilities of the chemical laboratory at Trinity College, Hartford, Connecticut, and its staff have been offered to the Government to carry on research for defense, should they be needed. The laboratory is under the direction of Professor Vernon K. Krieble, F.A.I.C.

BOOKS

FUNDAMENTALS OF SEMIMICRO QUALITATIVE ANALYSIS. By Erwin B. Kelsey and Harold G. Dietrich. *The Macmillan Company.* 1940. 5½"x8¼", 350 pp., $2.75.

The authors, assistant professors in chemistry at Yale University, define "semimicro anaylsis" as "procedures of analysis which employ original samples of the order of 0.3 ml. (about 10 drops) and in which the amounts of the individual ions present average about 1 mg." Qualitative analysis is taught to illustrate experimentally the principles of solution equilibria and the properties of ions. Since the concentrations of ions present determines the delicacy of analytical tests, the volume of solution need not necessarily be great and semimicro analysis differs from macro procedures by a reduction in size of apparatus and the use of the centrifuge to replace filtration. Thus it reduces the consumption of reagents; makes it possible to issue individual kits containing the chemicals needed with consequent few trips to reagent shelves; and the centrifuge saves time lost in filtration.

The careful manipulation and precision necessary in semimicro analysis emphasize to the beginner that chemistry is an exact science and offer an opportunity to develop exceptionally good technique. "The purpose of this text is to offer a better means for teaching the fundamentals of analysis —not to replace all other techniques. It may be used either in general chemistry courses or in courses devoted entirely to qualitative analysis."

This is an excellent book which will be welcomed.

THE CHEMISTS' YEAR BOOK. Founded by F. W. Atack. Edited by E. Hope. *Chemical Publishing Company.* 1940. 3¾"x6". 1257 pp. $6.00.

The 1940 revised edition of the above publication has just been issued, and numerous additions and changes have been made to this recognized standard authority upon subject matters of interest to chemists in order to bring it up to date. Atomic weights have been revised, the sections dealing with the properties of organic and inorganic compounds have been enlarged, and the section on crystallography has been redrafted with a view of making it more useful to the general chemist. These are only a few of the sections which have been modernized and which present the latest authentic information upon their specific subject matter.

While the book was founded by a fellow of the Institute of Chemistry of Great Britain, and while the editor is a fellow of Magdalen College, Oxford, England, it is noticeable that a great deal of the information has been taken from United States sources, as, for instance, full details are given of the Du Pont nitrometer, and the section upon textile fibers and dyes consists largely of information obtained from sources originating in this country.

This publication is far more than simply a compilation and collection of scientific information, but also contains voluminous information relative to the practical application of chemistry to manufacturing, and hence, it presents both a scientific value and a practical value. The book is of such a size that it is readily handled, and the general arrangement of the subject matter

is most admirable as it allows of ready reference to any specific subject.

A particular feature of the publication is the method of examination and analysis of many commercial products, and the book, therefore, is of the greatest value to every chemist, whether he be interested in the pure science of chemistry or in the application of that science for the production of commercial results.

Elementary Quantitative Analysis. By Hobart H. Willard and N. Howell Furman. *D. Van Nostrand Company, Inc.* 1940. 3rd edition. XXI chap. and appendix. 531 pp. $3.25.

This well-known text has been thoroughly revised, reorganized for convenience and clarity, and brought up to date with the addition of recent procedures in quantitative analysis. New illustrations are used and problems different from those used in previous editions are presented.

The appendix contains a literature of analytical chemistry, author and subject indexes, with tables of logarithms, exponential expressions, and the solution of quadratic equations.

Among the chapters which have had considerable revision are those on Scientific Measurements, Theory of Neutralization, Theory of Oxidation Reduction Methods, Procedures in the Field of Acidimetry and Alkalimetry, Quantitative Separations, and Theory of Electrolytic Precipitations. A new chapter on colorimetry has been added.

This new edition of the excellent text by Dr. Hobart H. Willard of the University of Wisconsin and Dr. N. Howell Furman of Princeton University will be popular among teachers and students alike.

A Laboratory Handbook and Syllabus for a First Year Course in Chemistry. By Roland M. Whittaker, F.A.I.C., *Department of Chemistry, Queens College,* New York, N. Y. 1940. 548 pp. Spiral Binding. 6″x9″. $1.00.

This second edition of this laboratory handbook is an extension of the first edition and is the result of the author's years of experience with first year students in chemistry.

The author states that he has made an attempt to "provide a series of laboratory experiments that can be used with any of the standard first year college texts in chemistry; to provide a series of report blanks, the completion of which will train the student in the art of observation; to provide a series of problems related to the subject matter of each unit; to provide a syllabus in the form of study questions to guide the student through the voluminous subject matter of the first year course; to provide discussion on specialized subjects some of which are discussed in all texts but all of which do not appear in every text." No reviewer could give a clearer or more explicit statement of the intentions of the author.

A further valuable feature of the publication is that the questions are so worded as to be more difficult to answer if the student depends upon his book knowledge than if he called upon his intelligence, thus enabling him to determine the relative importance of the many things he should learn and the means whereby he can arrange his information into a logical answer. The laboratory report blanks set up throughout the book are so clear, concise and complete, that they could be referred to many years afterward with complete

knowledge of every physical and chemical detail which has resulted during the performance of the experiment; and it would be a wise thing if every director of a research laboratory would obtain one of these books and use these laboratory forms for application in his own laboratory.

The value of this book to every earnestly-minded student desirous of obtaining a thorough knowledge of the preliminary elements of chemistry will be evident upon even a casual examination of it.

The ninth issue of the Weston-Levine Vitamin Chart has just been published. Seven vitamins or groups of related vitamins are described under the following headings: Name and Description; Functions in the Body; Results of Deficiency or Absence; Most Potent Sources: Excellent Sources; Good Sources, and Concentrates for Medicinal Use. Two pages of explanation accompany the chart. This chart may be obtained from Roe E. Remington, F.A.I.C., The Windermere, Charleston, South Carolina, at ten cents for a single copy; one dollar and fifty cents for twenty copies; three dollars for fifty copies; five dollars for one hundred copies, and fifteen dollars for five-hundred copies.

The Annual Chemists' Salon of Photography will be held at the Hotel Stevens, Chicago, Illinois, December eleventh to fifteenth. Chemists who wish to submit prints may obtain entry blanks from the Salon Committee, Chicago Chemists' Club, 413 Hotel Stevens, Chicago, Illinois, before November 30, 1940.

The following complete volumes of publications listed are available. Please send inquiries to Box 10A.

Journal of Industrial and Engineering Chemistry, Volume **10** (Jan. to Dec. 1918).

Journal of The American Chemical Society, Volume **40** (Jan. to Dec. 1918).

Chemical Abstracts, Volume **12** (Jan. to Dec. 1918).

"PYREX" Brand Fritted Glassware

A new line of "PYREX" brand laboratory ware has recently been announced by the Laboratory and Pharmaceutical Division of the Corning Glass Works. It is known as "PYREX" brand fritted glassware and the bodies and fritted discs are made from "PYREX" brand chemical glass No. 774.

The Corning Glass Works holds the exclusive right to manufacture and sell fritted glassware under the following U. S. patents: 1,620,815; 1,887,126; 1,931,895 and 2,114,748.

The Eclipse Air Brush Company, Newark, New Jersey, has just issued a four page, eight by eleven inches folder showing the various types and sizes available in its line of "Pneumix" air-motored agitators. This folder will be sent free on request.

A meeting of the American Oil Chemists Society is scheduled to be held October second to fourth at the Stevens Hotel, Chicago, Illinois.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, etc. REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, and MARCH 3, 1933

Of THE CHEMIST, published monthly except June, July, and August at New York, N. Y., for October 1, 1940.

STATE OF NEW YORK } ss.
COUNTY OF NEW YORK }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Vera F. Kimball, editor, who, having been duly sworn according to law, deposes and says that she is the Editor of THE CHEMIST and that the following is, to the best of her knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Name of	Post Office Address
Publisher: THE AMERICAN INSTITUTE OF CHEMISTS,	233 Broadway, New York, N. Y.
Editor: Vera F. Kimball,	233 Broadway, New York, N. Y.
Managing Editor:	None
Business Manager:	None

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given).

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5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is——. (This information is required from daily publications only.)

Vera F. Kimball
(Signature of Editor)

Sworn to and subscribed before me this twenty-seventh day of September, 1940.

Marie A. Kurtzke, Notary Public
(My commission expires March 30, 1942.)

Harry L. Fisher, F.A.I.C. was recently elected an honorary member of the Chemical Metallurgical, and Mining Society of South Africa, Johannesburg.

Hillary Robinette, F.A.I.C., is now with the Commercial Solvents Corporation, Terre Haute, Indiana, to promote that company's textile specialties.

NOTICE

The next meeting of the National Council of THE AMERICAN INSTITUTE OF CHEMISTS will be held on Wednesday, November 20, 1940, at The Chemists' Club, New York, N. Y.

EMPLOYMENT

Chemists Available

COLLEGE TEACHER. American, Ph. D., F.A.I.C., Sigma Xi. Inorganic analytical, organic and industrial chemistry. Several years' university teaching, six years' experience in the chemical industry in heavy chemicals, analytical methods, control, supervision. Publications. Location anywhere. Please reply to Box 31, THE CHEMIST.

CHEMIST, F.A.I.C. B.S. and M.S. degrees. American. Over thirty years' experience in Agricultural Chemical work along soil, fertilizer and plant lines in both research and analytical capacity. Experienced in by-product waste utilization and patent searches. Available for consulting work. Please reply to Box 51, THE CHEMIST.

CHEMIST, J.A.I.C. B.S. 1940. Six months' experience during summers in rubber factory. Fluent French and German. Interested in position as laboratory assistant or translator. Please reply to Box 55, THE CHEMIST.

CHEMIST, F.A.I.C., A.C.S. Doctor of Chemistry. 29 years manufacturing and developing experience in intermediates, dyestuffs, metal salts and food products. Original manufacturing processes developed. Successful in handling labor. Considerable consulting and business experience. First class references. Please reply to Box 35, THE CHEMIST.

CHEMIST, J.A.I.C., A.B. degree 1940. Phi Beta Kappa. Two years of college work in analytical chemistry—qualitative and quantitative; also courses in inorganic, organic, physical chemistry. Interested in any chemistry work. Please reply to Box 53, THE CHEMIST.

Positions Available

United States Civil Service Examinations
(Number 104, unassembled)

CHIEF CHEMIST. For direct pyro cotton manufacture. Open.

CHIEF CHEMIST. Phar.D. or Ph.D. Pharmaceutical research and manage production. $3900 up.

CHEMISTS experienced in inorganic acid manufacture. $300 a month.

CHEMIST to manage production and development of water-proofing compounds.

CHEMIST for the manufacture of bakers' specialties. Open.

CHEMIST. Manganese analysis. Cuba.

CHEMIST experienced in manufacture of synthetic resins for paint and varnish manufacture.

CHEMIST experienced on applications of textile chemicals.

Please write Box 102, THE CHEMIST, 233 Broadway, New York, N. Y.